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MISSISSAGI RIVER BANK STABILIZATION PROGRAM AQUATIC MONITORING, 1987

Report No 88-185-K

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ABSTRACT

Water quality, fish spawning habitat and fish species distribution below Red Rock GS on the Mississagi River were monitored in 1987 as the final year of a three year study to determine the effect of bank stabilization on the aquatic environment. Water quality parameters indicated no detrimental effect to the river system. Spawning bed particle size analysis also indicated no significant variation in substrate composition. Any fines that may have been deposited on the spawning bed during earlier construction activities were probably resuspended during peaking operations and spring flooding. Yellow perch was the dominant fish species collected in 1987 during day sampling. They were only collected at control sites. The 1987 day fish catch was lower than in previous years with only four fish collected at the construction sites. However, the yearly variation in fish numbers and the yearly variation in fish abundance at sampling sites were not significant. Yellow perch, mottled sculpin and rock bass were the dominant species collected at night. Night fish abundance declined in 1987 with lower numbers of fish collected at the construction sites. The yearly variations in total fish numbers and total fish abundance at sampling locations were not significant. However, the total fish catch was significantly improved at the treated sites when compared to the cobble/boulder and sand control site fish catches. Significant variations were also present among years and substrates in adult and juvenile/young of the year fish abundances. The adult fish catch was greater at the treated sites while juvenile/young of the year numbers were greatest at cobble/boulder control sites. The survey results did not indicate any detrimental changes to the fish population in the study area as a result of the bank stabilization. The variation in fish abundance, distribution and species composition may have been related to low water levels during the 1987 survey, natural fish distribution and population changes and change in electrofishing equipment used.

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34-169-01	837.32	September 2, 1988	88-185-K

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EXECUTIVE SUMMARY

MISSISSAGI RIVER BANK STABILIZATION PROGRAM AQUATIC MONITORING, 1987

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River banks susceptible to erosion on the Mississagi River between Red Rock GS and Mississagi Chutes were stabilized with quarried stone between 1983 and 1985. Water quality, fish habitat and fish population monitoring programs commenced in 1983 to determine the effect of the bank stabilization work on the aquatic environment. Similar studies were conducted during construction in 1985 and following construction in 1987.

Water quality analysis results during the construction period indicated deterioration in water quality at the point of construction activity. However all water quality values were similar to ambient river water quality values 300 m downstream of the construction activity due to river dilution. The 1987 water quality survey indicated bank stabilization was not detrimental to the river water quality in the long term at late summer discharge levels. Bank stabilization may also have improved the average water quality below Red Rock GS by reducing erosion along the stabilized banks.

Substrate studies on a fish spawning bed downstream of construction activity indicated there was no significant difference in substrate components prior to construction in 1983, during construction in 1985 and following construction in 1987. Any suspended solids deposited on the spawning bed during upstream construction activity were probably resuspended and transported further downstream during peaking operations and spring flooding.

The number of fish collected during the day in 1987 was less than in 1983 and 1985. Yellow perch was the dominant fish species collected in 1983 and 1987. Mottled sculpin was the dominant fish species in 1985. Mottled sculpin were present in the 1983 catch but absent in 1987. Walleye were collected in 1983 and 1985 but were not present in 1987. Fish catches at construction sites were generally lower in 1987. Fish catches at control sites in 1987 were generally higher or slightly lower than in previous years. However the yearly variation in fish numbers and the variation in fish abundance at construction sites and control sites with similar habitat were not statistically significant.

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Fish abundance at night was lowest in 1987 and highest in 1983. Yellow perch was the dominant fish species in 1983 and 1987. Rock bass and logperch were the dominant species collected in 1985. All of these fish species were present during each sampling year. Statistical analysis indicated the yearly variation in total fish catch was not significant. Fish abundance at control and construction sites in each sampling year did not follow any general trend. Fish abundance was greater at the construction sites in 1983 and 1985 but fish abundance was greater at the cobble-boulder control sites in 1987. This variation in fish abundance at the construction sites and control sites with similar habitat was significant with increased catches at the treated bank sites. Adult abundances were significantly different among years and among substrate types. The 1985 and 1987 adult fish catch was significantly greater than in 1983 with a significant increase in adult fish collected at the treated bank sites. Juvenile/young of the year fish catch was significantly greater in 1983 and 1987 than in 1985 with a significantly greater abundance at the cobble - boulder control sites than the treated or sand control sites.

The variation in yearly fish abundance may be attributable to natural fish distribution and year class strength. The 1987 fish catch results may also have been influenced by low river water levels. Shoreline areas sampled in 1983 and 1985 were above the water level in 1987 with only the lower sections of the bank stabilization material underwater. Areas vegetated with aquatic macrophytes in 1983 and 1985 were exposed as were areas of in-stream log cover. The variation in the 1987 catches may also be attributable to the different electrofishing gear used in 1987. However, the fish catch results indicated the placement of the quarried stone was probably not detrimental to the fish population within the study area.

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MISSISSAGI RIVER BANK STABILIZATION PROGRAM AQUATIC MONITORING, 1987

1.0 INTRODUCTION

Mississagi River bank stabilization activities were performed by Ontario Hydro during the 1983 to 1986 period. The stabilization work was conducted between Red Rock GS and the Mississagi Chutes on river banks susceptible to river erosion. Bank stabilization allowed Ontario Hydro to continue operating Red Rock GS as a peaking station without augmenting downstream river bank erosion. Bank stabilization activities also reduced the erosion attributable to natural occurrences.

Aquatic monitoring studies were conducted yearly from 1983 to 1985 and in 1987 to assess the effect of bank stabilization construction operations and materials on the Mississagi River aquatic environment. These studies were performed at the request of the Environmental Studies and Assessments Department (ES&A) of Design and Development Division by Biological Research and ES&A staff. The effect of bank clearing, rock placement and final shaping operations on the aquatic environment was monitored in 1983 (OHRD Report 84-144-K). Water quality and habitat monitoring studies were performed by ES&A personnel in 1984 while construction was in progress. The 1985 studies were similar in design to the 1983 program with construction activities in progress at undisturbed 1983 sites (OHRD Report 87-171-K). The 1987 study was the final proposed monitoring study and was modelled after the 1983 and 1985 studies. This program was conducted after construction activities were completed.

2.0 METHODS

2.1 Water Quality

Water samples were collected August 26 at Red Rock GS tailrace (1300 hours) and Mississagi Chutes (1000 hours, Figure 2.0-1). The samples were collected by immersing 1-litre borasilicate glass bottles to a depth of 1 m off of the river bed. The samples were refrigerated and submitted to the Ontario Hydro Research Division Analytical Services Section laboratory for analysis of conductivity, non-filtrable residue at 105 and 550°C, filterable residue at 105 and 550°C and turbidity.

2.2 Spawning Habitat

Rainbow trout and pink salmon utilize a gravel bar 50 m downstream of the west side of the centre span of the Highway 17 bridge in the town of Iron Bridge for spawning (Figure 2.0-1). Triplicate substrate samples were collected from the gravel bar August 26 with a 12 cm diameter pipe sampler to determine particle size distribution and any construction effects on the spawning area as in the 1983 and 1985 studies. The loss of fines was minimized by enclosing the pipe sampler in a plastic bag as it was removed from the substrate. Each sample was sieved through a series of 8 Tyler Canadian Standard Series sieves (31.5 - 0.0038 mm) using the wet sieving method. The samples were then oven dried to a constant weight and the results expressed as per cent by weight in each particle size range. Analysis of variance (ANOVA) was used to determine whether the gravel bar substrate components were significantly altered during construction activities.

2.3 Fish Monitoring

Ten shoreline sites (Figure 2.0-1), approximately 100 m in length, were selected in 1983 for assessing the effect of the quarried stone (20.3 cm minus) on fish productivity and habitat (OHRD Report 84-144-K). Four sites were selected as altered habitat locations (construction sites) while 6 sites were designated as control locations. The positions of four control locations were slightly altered within similar habitat in 1985 to avoid areas of new rock placement. The electrofishing site commencement and termination points were marked with either reflective tape or white marker buoys. Water levels in the Mississagi River downstream of Red Rock GS in 1987 were lower than in 1983 and 1985. Fish sampling sites were therefore situated further towards midstream in 1987 than in prior sampling years.

A Smith Root Model SR-12 electrofishing boat was used during the 1987 survey. The prior electrofishing studies were conducted with a 7 m Boston Whaler equipped with a Smith Root Mark VI electrofisher (OHRD Report 84-144-K). Ontario Hydro acceptance of the Ontario Ministry of Natural Resources electrofishing guidelines (OMNR 1986) necessitated the switch in electrofishing equipment. The SR-12 electrofisher was operated on a pulsed direct current (DC) at 120 pulses per second with a pulse width of 3 - 4 milliseconds. The voltage (V) ranged between 50 and 500 VDC at an amperage of approximately 3 - 4 amps. River water conductivity was approximately 9 mS/m. The electrofishing boat was equipped with lights to illuminate the fishing locations during the night studies as in previous sampling years.

The fish populations were sampled the nights of August 25 - 26 and 26 - 27 and during the day on August 25. Fish catch data was log-transformed and analyzed with one way analysis of variance (ANOVA) and Duncan procedure multiple range tests using SPSS/PC statistical program software.

3.0 RESULTS

3.1 Water Quality

The water quality analysis results from the Red Rock GS tailrace and Mississagi Chutes water samples are presented in Table 3.1-1. Filterable residue values at 105 (3.0 mg/L) and 550°C (<1 mg/L) were identical at each of the collection sites. Turbidity was slightly higher at Red Rock tailrace (1.2 NTU) than at Mississagi Chutes (1.0 NTU). Specific conductance and non-filtrable residue values at 105 and 550°C were higher at the Red Rock GS tailrace than at the Mississagi Chutes. The Mississagi Chutes sample was collected at 1000 hrs while the Red Rock GS tailrace sample was collected at 1300 hrs on the same date.

Table 3.1-1

Water Quality Analysis Results Mississagi River, 1987

Analyte	Red Rock GS Tailrace	Mississagi Chutes
Turbidity (NTU)	1.2	1.0
Conductivity (mS/m)	11.4	7.6
Filterable Residue 105 °C (mg/L)	3.0	3.0
Filterable Residue 105°C (mg/L)	<1.0	<1.0
Non-filterable Residue 105 °C (mg/L)	110.0	55.0
Non-filterable Residue 550 °C (mg/L)	37.0	7.0

3.2 Spawning Habitat

The spawning bed substrate particle size distribution results are presented in Table 3.2-1. The pebble-gravel (2.00 - 31.5 mm) substrate fraction was dominant, comprising a mean value of 48.4% of the substrate. Pebble (> 31.5 mm) and coarse sand (0.500 - 2.0 mm) were the other dominant substrate components forming 28.8 and 19.1% of the substrate respectively. Medium (0.250 - 0.500 mm) and fine sand (0.125 - 0.250 mm) formed 3.2 and 0.3% of the substrate respectively. Fine substrate components (<0.125 mm) comprised less than 0.1% of the substrate composition.

Table 3.2-1

Spawning Bed Particle Size Analysis Mississagi River 1987

Per Cent Composition Retained

Sieve Opening (mm)	Replicate 1	2	3	$\bar{x}$
31.5	36.3	24.6	25.9	28.9
2.00	43.0	49.8	52.5	48.4
1.00	4.1	15.7	16.6	12.1
0.500	11.8	6.0	3.1	7.0
0.250	4.3	3.5	1.8	3.2
0.125	0.4	0.3	0.2	0.3
0.063	0.1	<0.1	<0.1	<0.1
0.038	<0.1	<0.1	<0.1	<0.1
<0.038	<0.1	<0.1	<0.1	<0.1

3.3 Fish Monitoring

3.3.1 Day

Eight fish species totalling 44 fish were collected in the daylight electrofishing period (Appendix A). Three unidentified Cyprinidae and 3 unidentified fish were also collected and included in the fish catch total. Three mottled sculpin at station H and 4 unidentified fish at station G escaped capture and are not included in the fish catch total. The greatest number of fish species were sampled at control site C (number (n) = 5). Yellow perch (n = 26) and white sucker (n = 10) were the dominant fish species collected. The majority of fish were collected at control site A (n = 23) and control site C (n = 10). Young of the year yellow perch were the dominant fish collected at site A. No fish were collected at control site B or construction sites F and G. A total of four fish was collected at the remaining two construction sites (E & H).

3.3.2 Night

A total of 470 fish comprising 15 fish species was collected during the two night electrofishing periods (Appendix B). Yellow perch (n = 148), mottled sculpin (n = 109) and rock bass (n = 73) were the dominant fish species sampled. Rock bass, smallmouth bass and mottled sculpin were each present at nine of the ten sampling sites. Yellow perch were collected at seven of the sites. The majority of fish species (n = 10) were collected at control site C and control site I. Nine species were collected at control site J while seven species were collected at control sites A and B.

The mean fish abundance was highest at control sites A ($\bar{x}$ = 52.0 fish/100 m of shoreline) and C ($\bar{x}$ = 39.0 fish/100 m of shoreline, Table 3.3-1). Construction site mean fish abundance was highest at site G ($\bar{x}$ = 34.0 fish/100 m of shoreline). Lowest numbers of fish were collected at construction site E ($\bar{x}$ = 8.5 fish/100 m of shoreline) and control site B ($\bar{x}$ = 12.0 fish/100 m of shoreline).

The mean fish abundance was greater at the cobble-boulder control sites ($\bar{x}$ = 32 fish/100 m of shoreline) rather than at the sand and aquatic vegetation control sites ($\bar{x}$ = 21.6 fish/100 m of shoreline) and construction sites ($\bar{x}$ = 21.1 fish/100 m of shoreline, Table 3.3-2). Adult fish were predominant at the construction sites ($\bar{x}$ = 19.3 fish/100 m of shoreline) while young of the year fish were predominant at the cobble-boulder control sites ($\bar{x}$ = 19.0 fish/100 m of shoreline). Adult ($\bar{x}$ = 10.6 fish/100 m of shoreline) and young of the year ($\bar{x}$ = 10.8 fish/100 m of shoreline) fish were equally distributed at the sand and aquatic vegetation control sites. Yellow perch was the dominant species at the cobble-boulder ($\bar{x}$ = 18.0 fish/100 m of shoreline) and sand and aquatic vegetation ($\bar{x}$ = 9.4 fish/100 m of shoreline) controls. Mottled sculpin ($\bar{x}$ = 11.9 fish/100 m of shoreline) was the major fish species at the treated construction sites.

The majority of fish collected at sand and aquatic vegetation control sites were collected upstream of the construction areas (Table 3.3-2). These fish were primarily young of the year fish ($\bar{x}$ = 18.3 fish/100 m of shoreline). Adult fish were more predominant in the downstream control catches ($\bar{x}$ = 12.8 fish/100 m of shoreline). Yellow perch was the dominant fish species at the upstream sand and aquatic vegetation controls ($\bar{x}$ = 18.0 fish/100 m of shoreline) while rock bass ($\bar{x}$ = 6.0 fish/100 m of shoreline) was the predominant fish species collected at the downstream controls.

Table 3.3-1

Fish Abundance (number of fish/100 m of shoreline) Night Sampling Sites
Mississagi River 1983 - 1987

Site	Total Number			Number Without Salmonids			Adults			Young of Year			Site Description
	1983	1985	1987	1983	1985	1987	1983	1985	1987	1983	1985	1987	
A	49.3	20.5	52.0	12.3	13.5	50.5	5.7	13.0	14.0	6.6	0.5	36.5	Red Rock, Tailrace Cobble
B	12.0	16.5	12.0	12.0	16.5	12.0	11.0	16.5	10.5	1.0	0.0	1.5	Shino Rapids, Cobble
C	32.0	7.5	39.0	32.0	7.0	38.5	9.0	6.5	14.5	23.0	0.5	24.0	Control, Sand and Debris
D	9.0	4.5	15.5	9.0	4.5	15.0	6.0	4.5	2.5	3.0	0.0	12.5	Control, Sand and Debris
E	38.0	39.5	8.5	38.0	39.5	8.5	5.0	39.5	8.0	33.0	0.0	0.5	Quarried Stone, East Bank
F	118.0	30.0	22.0	118.0	30.0	22.0	11.0	30.0	20.5	107.0	0.0	1.5	Quarried Stone, West Bank
G	9.0	44.0	34.0	9.0	44.0	34.0	5.0	44.0	32.0	4.0	0.0	2.0	Quarried Stone, East Bank*
H	10.0	38.5	20.0	10.0	38.5	19.5	2.0	37.5	16.5	8.0	1.0	3.0	Quarried Stone, East Bank#
I	23.0	13.0	15.0	23.0	13.0	15.0	22.0	12.5	11.0	1.0	0.5	4.0	Control, Sand and Debris
J	24.0	40.5	17.0	24.0	40.5	17.0	4.0	40.5	14.5	20.0	0.0	2.5	Control, Sand and Vegetation

* Debris Cleared, Sand (1983)
\# Debris Cleared, Sand and Vegetation (1983)

Table 3.3-2

Fish Abundance at Shoreline Types
(number of fish/100 m of shoreline) Mississagi River 1987

QUARRIED STONE AND COBBLE -BOULDER SITES

	Control (sites A, B)	Treated (sites E, F, G, H)
Mean Number	32.0	21.1
Mean Number Without Salmonids	31.3	21.0
Mean Number of Adults*	12.3	19.3
Mean Number of Young of Year*	19.0	1.8
Yellow Perch	18.0	0.1
Mottled Sculpin	2.8	11.9

SAND AND AQUATIC VEGETATION SITES

	Control (sites C, D, I, J)		
	Upstream C, D	Downstream I, J	Combined
Mean Number	27.3	16.0	21.6
Mean Number Without Salmonids	26.8	16.0	21.4
Mean Number of Adults*	8.5	12.8	10.6
Mean Number of Young of Year*	18.3	3.3	10.8
White Sucker	3.5	1.5	2.5

* - without Salmonids

4.0 DISCUSSION

4.1 Water Quality

Water quality values were generally similar between the Red Rock GS tailrace and Mississagi Chutes on a temporal and spatial basis (Table 4.1-1). Turbidity values ranged from 0.23 NTU at Red Rock GS (July, 1983) to 1.6 NTU at the Mississagi Chutes (October, 1983). The higher October value was determined during station peaking operation while bank stabilization work was in progress. The turbidity value at Red Rock GS tailrace was 1.2 NTU on the same date.

Table 4.1-1

Water Quality Analysis Mississagi River 1983 - 1987

		Parameter					
		TURB	COND	FR*	FR	NFR#	NFR
		NTU	mS/m	105	550	105	550
DATE	SITE			mg/L	mg/L	mg/L	mg/L
Jul 1983	Red Rock	0.23	5.6	3.3	<1	50	24
	Mississagi	0.28	5.7	1.0	<1	58	12
Aug 1983	Red Rock	0.42	5.9	<1	<1	66	14
	Mississagi	0.68	6.2	<1	<1	60	10
Oct 1983	Red Rock (normal)	0.62	6.1	2.0	<1	54	41
	Mississagi (normal)	1.4	6.6	2.0	<1	60	32
	Red Rock (peaking)	1.2	6.1	1.0	<1	52	33
	Mississagi (peaking)	1.6	6.1	1.0	<1	52	28
Aug 1984	Red Rock	0.8	6.6	2.0	<2	35	6
Aug 1987	Red Rock	1.2	11.4	3.0	<1	110	37
	Mississagi	1.0	7.6	3.0	<1	55	7

* - filterable residue

- non-filterable residue

Specific conductance values ranged from 5.6 mS/m (July, 1983) to 11.4 (August, 1987) mS/m at the Red Rock GS tailrace. Specific conductance values at Mississagi Chutes ranged from 5.7 to 7.6 mS/m on the same dates. The 1987 Mississagi Chute water sample was collected prior to the Red Rock GS tailrace sample and thus does not reflect the higher Red Rock GS tailrace specific conductance value. However it does indicate variability unrelated to construction activity within the river system. The reason for the high Red Rock GS August, 1987 specific conductance value (11.4 mS/m) is unknown. It was higher than any specific conductance value recorded within the water quality sampling program during construction operations regardless of station operation.

The non-filtrable residue values at 105°C ranged from 35 (Red Rock GS, 1985) to 110 mg/L (Red Rock GS, 1987). The 1987 level (110 mg/L) was associated with the increase in specific conductance on the same date and was indicative of an increase in soluble substances within the river system upstream of the sampling location. The origin of these dissolved substances is unknown. However the levels did not exceed the Ontario Ministry of Environment (OMOE) provincial water quality objectives (1984).

The non-filtrable residue levels at 550°C ranged from 6 (1984) to 41 mg/L (October, 1983). Both values were determined at the Red Rock GS tailrace. The maximum non-filtrable residue at 550°C value was recorded during station peaking operations after bank stabilization activities had commenced. The highest Mississagi Chutes non-filtrable residue at 550°C value (32 mg/L) occurred on the same date.

Filterable residue levels at 105°C were low ranging from <1 (August, 1983) to 3.3 mg/L (July, 1983) at the Red Rock GS tailrace. The maximum reading at the Mississagi Chutes was 3.0 mg/L (1987) which was the same as the Red Rock GS tailrace value on the same date. All filterable residue at 550°C values were below detection limits (<2 mg/L) on all sampling occasions. These values indicated low levels of suspended organic materials (< 1 mg/L) within the sampling area.

Water quality generally deteriorated at the point of construction activity during the 1983 to 1985 construction period (OHRD Reports 84-144-K and 87-171-K). However, water quality at that time generally returned to near ambient conditions within 300 m of the construction operation. The 1987 water quality results indicated the bank stabilization activities were not detrimental to the river water quality.

4.2 Spawning Habitat

Comparison of the 1983, 1985 and 1987 particle size analysis results indicated the spawning bed located south of the Highway 17 bridge in the town of Iron Bridge was not adversely affected by the construction activity. The mean spawning bed particle sizes for the early construction period (July, 1983) and the post construction period (1987) are very similar (Figure 4.2-1). Gravel was the dominant substrate component in each year forming 52.3 and 48.4% of the substrate in 1983 and 1985 respectively. Pebble formed 28.9% of the substrate in each year. Coarse sand was more predominant in the 1987 sample (19.1%) than in 1983 (14.6%) while medium sand was slightly higher in 1983 (3.9%) than in 1987 (3.2%). All particle sizes less than medium sand were similar on the two sampling dates. The variation between the early and post construction particle size range per cent composition was not significant (Table 4.2-1).

FIGURE 4.2-1

SPAWNING BED PARTICLE SIZE
MISSISSAGI RIVER, 1983 - 1987

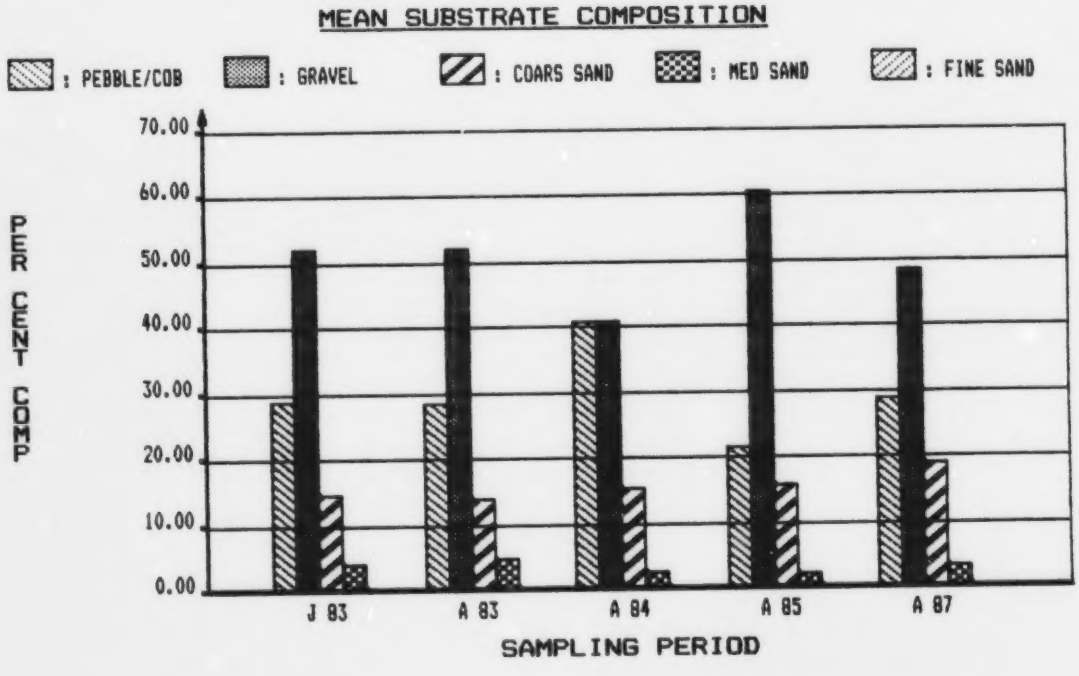


Table 4.2-1

Spawning Bed ANOVA Tables Mississagi River 1983 - 1987

	Yearly Variation 1983 - 1987			Early (Jul 1983) vs Post (Aug 1987) Construction Variation		
Particle Size (mm)	Sig	DF	F value	Sig	DF	F value
>31.5	NS	4,10	1.82817	NS	1,4	3.41797E-03
2.00 - 31.5	NS	4,10	1.89162	NS	1,4	0.137539
1.00 - 2.00	NS	4,10	2.81200	NS	1,4	4.26723
0.500 - 1.00	NS	4,10	3.07306	NS	1,4	1.94121
0.250 - 0.500	S	4,10	5.40102	NS	1,4	0.655719
0.125 - 0.250	S	4,10	4.25000	NS	1,4	1.66672E-03
0.063 - 0.125	NS	4,10	2.98023E-09	NS	1,4	7.45058E-09
0.138 - 0.063	NS	4,10	2.98023E-09	NS	1,4	7.45058E-09
<0.038	NS	4,10	2.98023E-09	NS	1,4	7.45058E-09

ANOVA results also indicated the yearly variation (1983, 1985, 1987) in the percent composition of substrate materials in the 0.250 - 0.500 and 0.125 - 0.250 mm size ranges was significant ($P<0.05$, Table 4.2-1). The mean medium sand (0.250 - 0.500 mm) per cent composition was highest during the August 1983 construction period. The mean medium sand per cent composition decreased in 1984 and 1985 but increased to near the pre construction per cent in 1987 (3.2%). The 0.125 - 0.250 mm substrate component mean per cent values ranged from 0.1 in 1985 to 0.4 in August of 1983. The variation in these two particle size ranges is probably attributable to natural variation in substrate composition at the sampling site rather than to construction effects since the medium sand component increased in 1987 after construction had been completed.

4.3 Fish Monitoring

4.3.1 Day

The total number of fish collected in the day electrofishing periods declined from 1983 (n = 120) and 1985 (n = 125) to 50 in 1987. Ten fish species were collected in each of the 1983 and 1985 sampling periods while eight fish species were identified in 1987; although 3 unidentified Cyprinidae and 3 unidentified fish were also collected in 1987. Sixteen fish species were collected throughout the study period. Redhorse sucker, rock bass and yellow perch were the only species collected in each of the sampling years. Yellow perch was the dominant species in 1983 and 1987 (Table 4.3-1) while mottled sculpin was the dominant species in 1985. Mottled sculpin

were not collected in 1983 but were present in the 1987 catch. Walleye were collected in 1983 and 1985 but were absent in the 1987 catch.

The greatest number of fish (n = 61) was collected at construction site E in 1985 (Figure 4.3-1). These fish were primarily mottled sculpin (n = 51). Fifty - four fish, primarily yellow perch (n = 52) were collected at construction site H in 1985 while 37 fish, primarily Cyprinidae (n = 35), were captured at control site I in the same year. The greatest 1987 catch was at control site A (n = 23). The majority of these fish were yellow perch (n = 20). The fish catch at control site B was consistently low with only 1 fish captured (1983) during the three sampling periods. Fish catches at control site D (n = 9) and construction site F (n = 9) were also low.

Fish numbers decreased at construction sites E, F and G in 1987 (Figure 4.3-1). Fish numbers at these sites had previously increased in 1985 from the 1983 survey catch. Zero (1985) and 1 fish (1987) were collected at the fourth construction site (H). These catches were well below the 1983 fish catch (n = 54). Fish catches increased in 1987 at control sites C and D and were similar to the 1983 and 1985 catches at site A. The 1985 and 1987 catches at control site I were similar but were lower than the early construction catches. The 1983 and 1987 fish catches at site J were slightly lower than in 1985. ANOVA results indicated there were no significant differences in the fish catches (total, adult or young of the year) among individual sampling sites or substrate types (cobble, sand and treated sites, Appendix C).

The 1987 fish catches may have been influenced by low water levels within the Mississagi River system during the 1987 sampling period. Shoreline areas sampled in the 1983 and 1985 studies were above the water level in 1987. Only the lower areas of the bank stabilization material were underwater at the construction sites. Therefore the 1987 survey fish catches primarily reflect fishes utilizing more of the natural river habitat rather than the habitat created by bank stabilization materials. Control site habitat was also affected by the lower water levels. Vegetative cover and debris that was present in the 1983 and 1985 studies were out of the water in 1987. Thus the potential amount of fish cover and habitat was reduced in 1987 compared to earlier surveys.

4.3.2 Night

Fifteen fish species were identified in each of the sampling years with 20 species collected throughout the survey. Eleven fish species were present each year. Rosyface shiner was present only in the 1987 survey catch (Appendix B). Yellow perch was the dominant fish species in 1983 and 1987 (Table 4.3-1). Rock bass and logperch were the dominant 1985 species collected. All of these species were present in the fish catch during each sampling year. The five dominant fish species in 1985 and 1987 were the same with variation in the order of dominance between the two years. Yellow perch and logperch were the only dominant species common to the three sampling years. Fish abundance was lowest in 1987 (23.5 fish/100 m of shoreline) continuing the general trend of declining fish abundance from 1983 (32.4 fish/100 m of shoreline) and 1985 (25.5 fish/100 m of shoreline).

Table 4.3-1

Dominant Fish Species (mean number/100 m of shoreline)
Mississagi River 1983 - 1987

DAY SAMPLING

YEAR 1983		1985		1987	
SPECIES	#	SPECIES	#	SPECIES	#
Yellow Perch	62	Mottled Sculpin	54	Yellow Perch	26
Cyprinidae*	35	Pink Salmon	20	White Sucker	10
Logperch	9	Logperch	19		
		Yellow Perch	15		

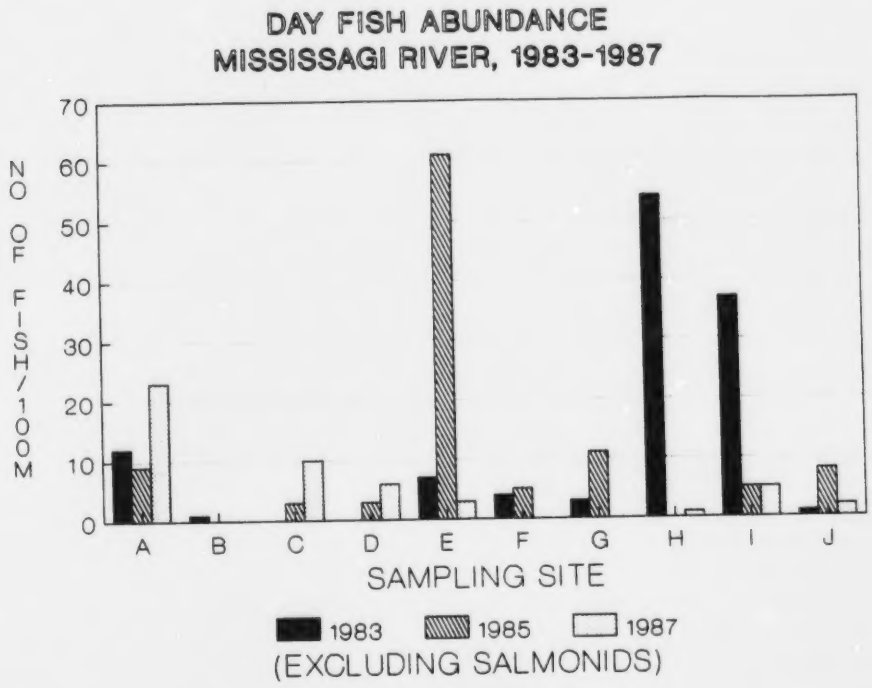
NIGHT SAMPLING

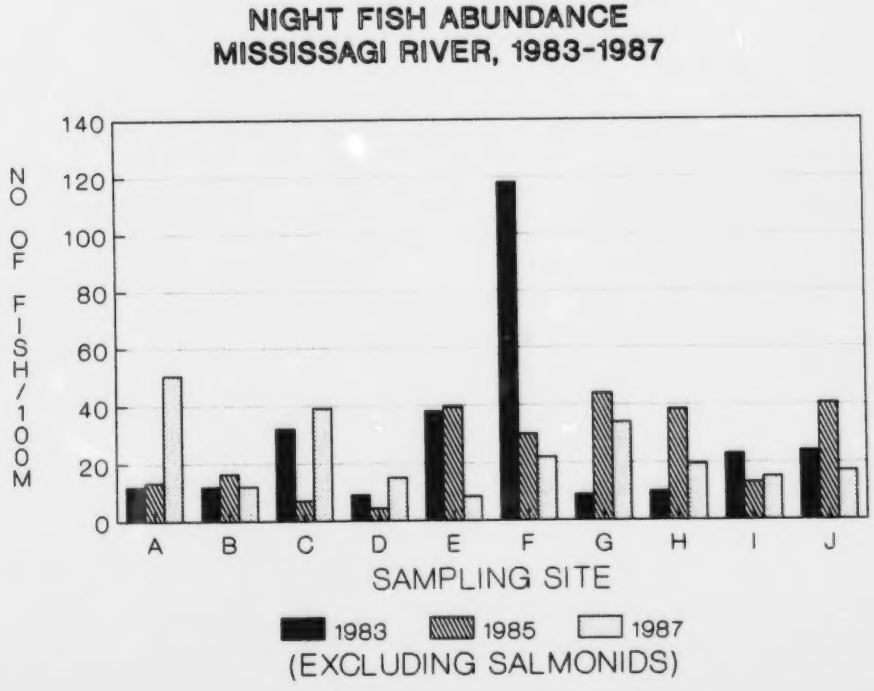
YEAR 1983		1985		1987	
SPECIES	#	SPECIES	#	SPECIES	#
Yellow Perch	21.2	Rock Bass	7.4	Yellow Perch	7.4
Pink Salmon	3.6	Logperch	7.1	Mottled Sculpin	5.5
Cyprinidae*	2.8	Yellow Perch	3.6	Rock Bass	3.7
Logperch	1.7	Mottled Sculpin	3.5	Logperch	1.5
Walleye	1.3	Smallmouth Bass	1.1	Smallmouth Bass	1.4

Fish abundance (without Salmonids) was greatest at construction site F in 1983 (118.0 fish/100 m of shoreline) and at control site A in 1987 (50.5 fish/100 m of shoreline, Table 3.3-1, Figure 4.3-1). Lowest fish numbers were collected at control site D in 1985 (4.5 fish/100 m of shoreline). Mean fish abundance was greatest at construction sites F ($\bar{x}$ = 56.7 fish/100 m of shoreline), G ($\bar{x}$ = 29.0 fish/100 m of shoreline) and E ($\bar{x}$ = 28.7 fish/100 m of shoreline). The lowest mean construction site fish abundance was recorded at site H ($\bar{x}$ = 22.7 fish/100 m of shoreline). Mean fish abundance at the control sites ranged from 28.5 fish/100 m of shoreline at site E to 13.5 fish/100 m of shoreline at site B. Neither the yearly variation in fish catch nor the variation in fish catch at sampling locations were significant (Appendix C).

FIGURE 4.3-1

Fish Abundance (excluding Salmonids)
Mississagi River, 1983 - 1987





The mean number of fish collected at the control and construction sites during each sampling year did not follow any general trend. Fish abundance was greater at the quarried stone construction sites than at the cobble-boulder control sites in 1983 and 1985 (Figure 4.3-2). However the mean fish abundance was greater at the control sites in 1987. The variation between the total fish catches at the construction sites and the cobble-boulder and sand control sites was significant (Appendix C, P>0.05) with improved catches indicated at the treated sites (Appendix D, P>0.05).

The numbers of adult fish collected at the construction sites were lower in 1987 than in 1985 (Table 3.3-1 , Figure 4.3-3). This trend was apparent at 4 of the 6 control sites as well. The 1987 adult fish catches at sites A and C were greater than the 1983 and 1985 catches. The variation within the yearly adult fish abundance was significant (Appendix C, P>0.05) with higher fish abundances indicated in 1985 and 1987 (Appendix D, P>0.05) than in 1983. The adult fish catch was also significantly different by substrate type (cobble, sand and treated, Appendix C, P>0.05) with increased fish numbers indicated at the treated sites (Appendix D, P>0.05).

Juvenile/young of the year 1987 construction site catches were greater than the 1985 catches but less than the 1983 catches (Figure 4.3-3). The 1987 juvenile/young of the year fish catches at the control sites were greater than the 1985 control site fish catches and generally greater than the 1983 control fish catches as well. The yearly variation in juvenile/young of the year fish catches was significant (Appendix C, P>0.05) with the 1983 and 1987 fish catches significantly different than the 1985 catches (Appendix D, P>0.05) when very few fish were collected (n = 5). Significant variation was present in the juvenile/young of the year fish catch as well when compared by substrate type (cobble, sand and treated) with significantly greater catches occurring at the cobble/boulder control sites (Appendix D, P>0.05).

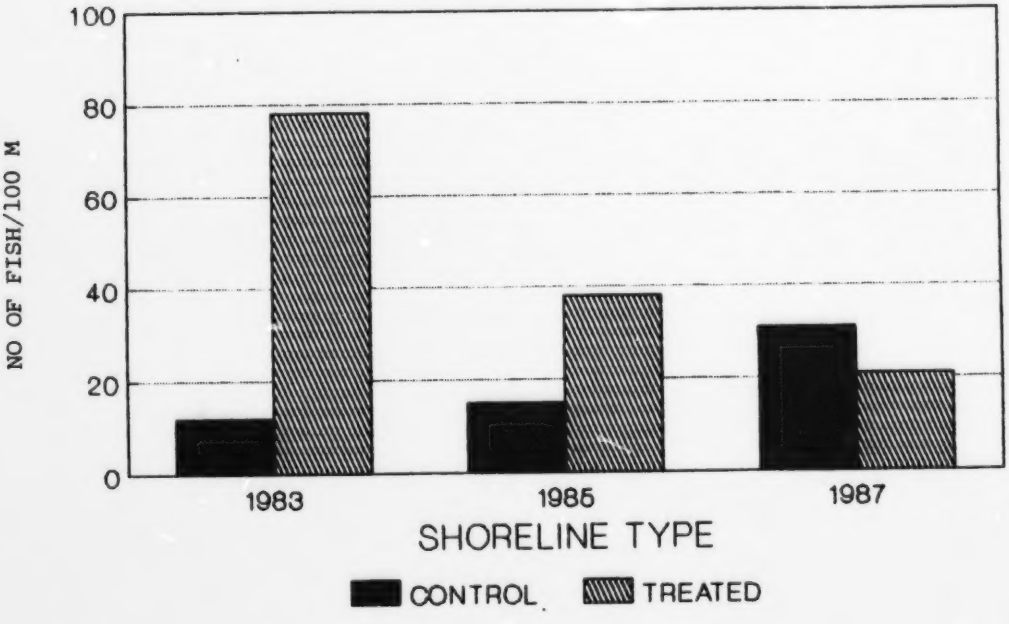
The statistical analysis indicated greater total fish and adult catches at the treated sites than at the control sites. However the fish catch may have been influenced by a number of factors. The 1987 sampling data are not entirely representative of the treated site habitat. The survey was conducted during a period of low water levels which exposed most of the shoreline bank stabilizing materials. Therefore most of the fish collected at the 1987 construction sites were utilizing the natural river habitat rather than the construction quarried stone habitat. Vegetative cover and debris were exposed at the control locations in 1987 as well which may have influenced the fish catch at the sand control locations. The yearly variation in fish catch and age class distribution at the construction and control sites may also be related to natural variation in fish distribution (OHRD Report 87-171-K) as well as to the change in shoreline habitat.

The electrofishing equipment used in the 1987 survey may also have influenced the fish catch. Ontario Hydro adoption of the OMNR electrofishing guidelines necessitated the change in electrofishing equipment in 1987. The electrofishing equipment used in 1987 produced the desired 3 - 6 amps (Reynolds 1983) when set between 50 and 500 volts. The voltage required in 1983 and 1985 to produce similar amperage was between 629 and 1008 volts. The 1987 equipment functioned at a pulse rate of 120 pulses per second while the pulse rate in earlier studies was 60 pulses per second. Lower pulse rates (5 - 40 pulses per second) have been reported to be more effective for spiny-rayed fishes than higher pulse rates (Novotny and Priegel 1974). Higher pulse rates (40 - 120 pulses per second) were more effective on soft-rayed and young of the year fishes. The optimal pulse rate for yellow perch collection was 15 - 40 pulses per second. The effectiveness of the electrofishing equipment in low conductivity waters is also dependent upon electrode size. The use of larger electrodes in low conductivity waters will increase the effectiveness of the electrofishing operation since the electrical field is limited to the immediate vicinity of the electrode (Reynolds 1983). The electrofishing electrode size was greater in the 1987 study than those used in the previous studies.

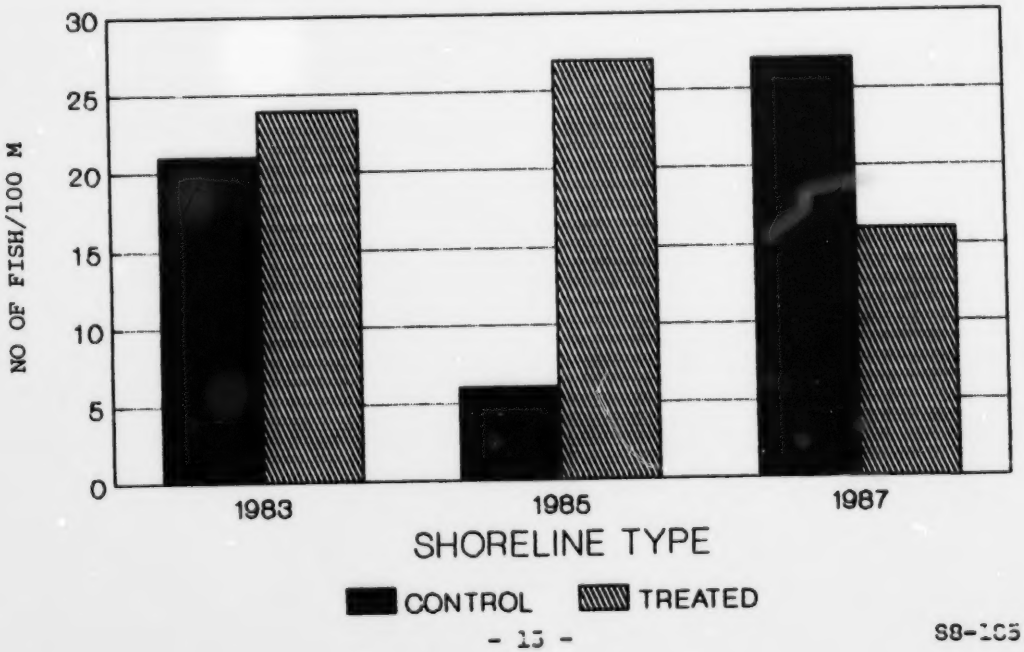
FIGURE 4.3-2

Night Fish Abundance at Shoreline Types
Mississagi River, 1983 - 1987

QUARRIED STONE AND COBBLE - BOULDER



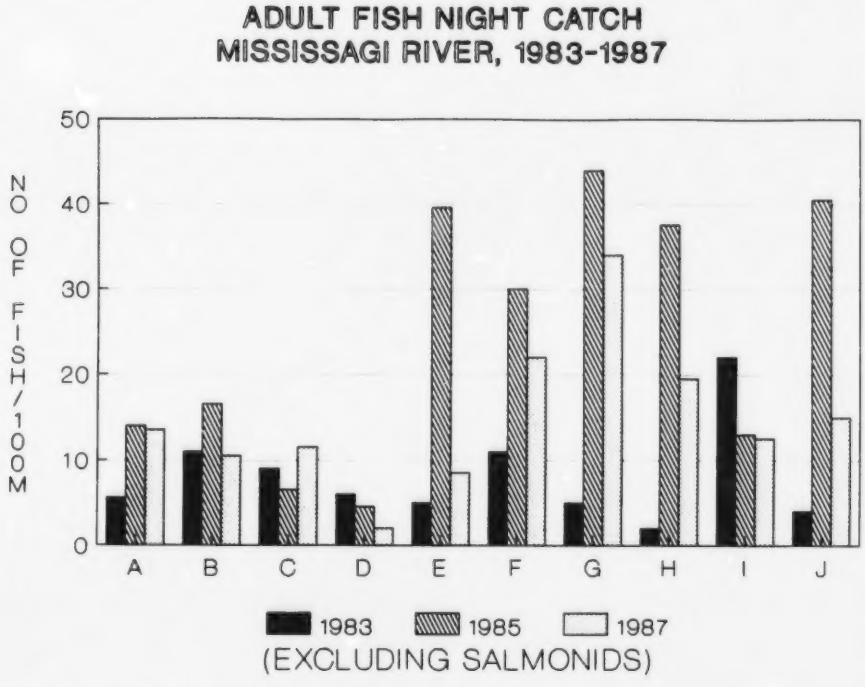
SAND AND AQUATIC VEGETATION

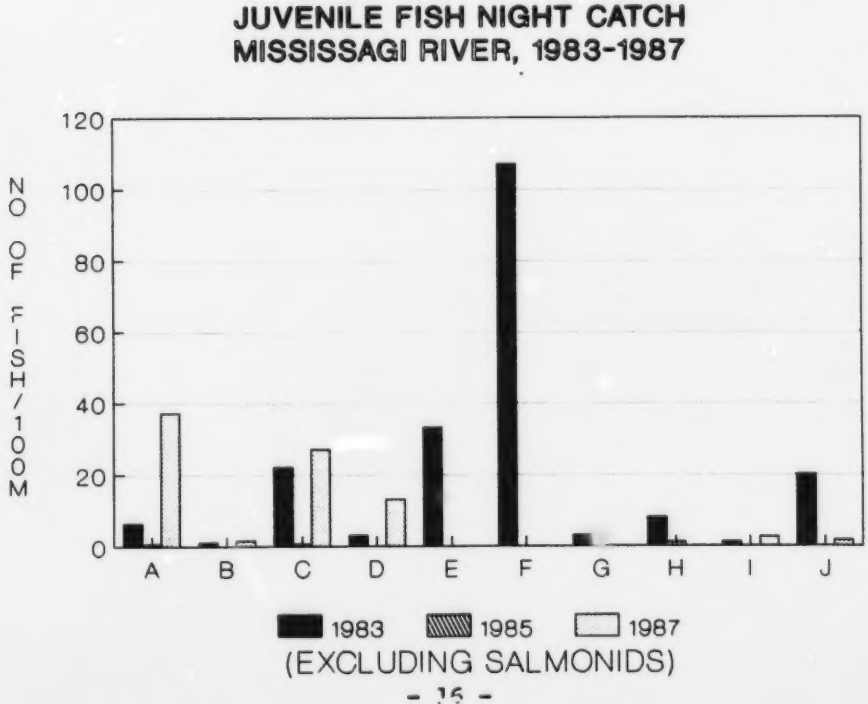


88-105

FIGURE 4.3-3

Night Fish Catch Age Distribution
(excluding Salmonids)
Mississagi River, 1983 - 1987





88-135

The results did indicate that the placement of the quarried stone at the bank stabilization areas was probably not detrimental to the fish population within the study area with fish population and species fluctuations occurring at the treated and control sites. Whether the utilized fish habitat was actually increased at the treated sites is unknown.

5.0 RECOMMENDATIONS

An additional survey of the fish species at the construction and control sites should be undertaken when water levels are similar to the 1983 and 1985 levels. This survey would identify any changes in the fish population at the treated bank sites. The survey should ideally be two weeks in duration and would be conducted with the equipment comparable to the equipment utilized in the 1983 and 1985 surveys.

6.0 ACKNOWLEDGEMENTS

Messrs. D. Lowther, L. King and G. Pope are thanked for their assistance in data collection. The electrofishing boat utilized during the study was provided by G. Goodchild of the Ontario Ministry of Natural Resources.

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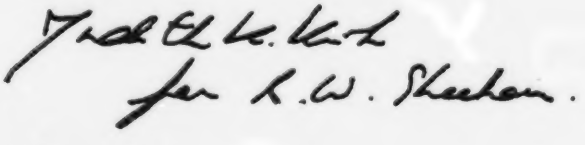

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Biological Research Section

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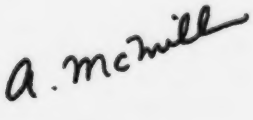

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REFERENCES

1. Novotny, D.W. and G.R. Priegel, 1974. Electrofishing Boats: Improved Designs and Operational Guidelines to Increase the Effectiveness of Boom Shockers. Wisconsin Department of Natural Resources, Technical Bulletin 73.

2. Ontario Hydro Research Division Report No. 84-144-K. Mississagi River Bank Stabilization Program Aquatic Monitoring 1983. R. W. Sheehan.

3. Ontario Hydro Research Division Report No. 87-171-K. Mississagi River Bank Stabilization Program Aquatic Monitoring 1985. R. W. Sheehan.

4. Ontario Ministry of the Environment, 1984. Water Management. Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment.

5. Ontario Ministry of Natural Resources, 1986. Manual of Instructions, Electrofishing Guidelines and Procedures. G.A. Goodchild.

6. Reynolds, James B. 1983. Electrofishing. Fisheries Techniques. Chapter 8. pg. 147-163. Amer. Fish. Soc. Bethesda Maryland. L. A. Nielson and D. L. Johnson, ed.

Appendix A

Day Sampling
Electrofishing Fish Catch
Mississagi River, 1987

Station	A	B	C	D	E	F	G	H	I	J	
Date	25	25	25	25	25	25	25	25	25	25	Total
Pink Salmon	1	-	-	-	-	-	-	-	-	-	1
White Sucker											
Adult	-	-	3	3	-	-	-	-	1	1	8
Juvenile	-	-	1	-	-	-	-	-	-	1	2
Redhorse Sucker	-	-	1	-	-	-	-	-	-	-	1
Rock Bass	-	-	1	-	-	-	-	-	-	-	1
Smallmouth Bass	2	-	-	-	-	-	-	-	-	-	2
Yellow Perch											
Adult	-	-	-	3	-	-	-	-	-	-	3
YOY	20	-	3	-	-	-	-	-	-	-	23
Mottled Sculpin	-	-	1	-	-	-	-	1#	-	-	2
Northern Pike	-	-	-	-	-	-	-	-	1	-	1
Cyprinidae	-	-	-	-	-	-	-	-	3	-	3
Unidentified	-	-	-	-	3	-	##	-	-	-	3
Total	23	0	10	6	3	0	0	1	5	2	50

- 3 mottled sculpin escaped

- 4 unidentified escaped

Appendix B

Night Sampling Electrofishing Fish Catch Mississagi River, 1987

Station	A		B		C		D		E		F		G		H		I		J		
Date	25	26	25	26	25	26	25	26	25	26	25	26	25	26	25	26	25	26	25	26	Total
Pink Salmon	3	-	-	-	1	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	6
White Sucker																					
Adult	-	-	-	-	3	3	-	1	-	-	-	1	-	-	-	-	-	-	-	-	8
Juvenile	-	-	-	-	-	7	-	1	-	-	-	-	-	-	-	-	1	-	-	-	9
Redhorse Sucker	-	-	-	-	3	1	1	-	-	-	2	1	-	-	-	-	5	-	1	2	16
Emerald Shiner	-	-	1	-	-	-	1	-	3	2	4	1	-	-	-	-	-	-	-	-	12
Spottail Shiner	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	3	6
Bluntnose Minnow	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	1	3	1	4	14
Rock Bass																					
Adult	-	3	2	5	2	-	-	-	2	3	1	4	4	9	4	9	-	4	3	9	64
YOY*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	5	1	2	9
Smallmouth Bass																					
Adult	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4
YOY	3	1	-	-	-	1	-	-	-	1	3	2	2	-	6	-	1	2	1	1	24
Yellow Perch																					
Adult	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	1	-	-	2	5
YOY	43	26	1	2	20	26	4	21	-	-	-	-	-	-	-	-	-	-	-	-	143
Walleye																					
Adult	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Juvenile	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Logperch	14	7	-	-	-	-	-	-	-	1	-	-	1	1	2	2	-	-	-	1	29
Mottled Sculpin	-	2	2	7	-	1	-	1	-	5	6	21	34	14	4	11	1	-	-	-	109
Northern Pike	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2
Johnny Darter	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	2	1	1	6
Rosyface Shiner	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total	64	40	8	16	35	43	6	25	5	12	13	31	42	26	11	29	13	17	8	26	470

Appendix C

Fish Catch ANOVA Tables Mississagi River, 1983 - 1987 (Excluding Salmonids)

Day Fish Catch

Variable Log Catch By Year - Total Catch

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	2	0.2744	0.1372	0.4716	NS
Within	27	7.8561	0.2910		

Variable Log Catch By Location - Total Catch

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	9	2.9714	0.3372	1.2799	NS
Within	20	5.1591	0.2580		

Variable Log Catch By Year - Adults

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	2	0.5614	0.2807	1.3341	NS
Within	27	5.6809	0.2104		

Variable Log Catch By Location - Adults

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	9	2.6335	0.2926	1.6216	NS
Within	20	3.6089	0.1804		

Variable Log Catch By Year - Juvenile, Young of Year

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	9	2.6335	0.2926	1.6216	NS
Within	20	3.6089	0.1804		

Appendix C Cont'd

Fish Catch ANOVA Tables Mississagi River, 1983 - 1987
(Excluding Salmonids)

Night Fish Catch

Variable Log Total Catch By Year

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	2	0.0045	0.0023	0.0219	NS
Within	49	5.0811	0.1037		

Variable Log Total Catch By Location

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	9	1.2682	0.1409	1.5503	NS
Within	42	3.8715	0.0909		

Variable Log Total Catch By Substrate Type (cobble/sand/treated)

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	2	0.8327	0.4163	4.7969	S
Within	49	4.2530	0.0868		

Variable Log Adult Catch By Year

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	2	1.4262	0.7131	7.8757	S
Within	49	4.4366	0.0905		

Appendix C Cont'd

Fish Catch ANOVA Tables Mississagi River, 1983 - 1987
(Excluding Salmonids)

Variable Log Adult Catch by Location

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	9	2.0693	0.2299	2.5456	S
Within	42	3.7935	0.0903		

Variable Log Juvenile/Young of Year Catch By Year

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	2	7.1887	3.5944	21.2131	S
Within	49	8.3026	0.1694		

Variable Log Juvenile/Young of Year Catch By Location

Source	DF	Sum of Squares	Mean Squares	F Ratio	Sig
Between	9	2.2258	0.2473	0.7830	NS
Within	42	13.2655	0.3518		

S - significant P>0.05
NS - not significant P>0.05

Appendix D

Fish Catch Multiple Range Test (Duncan Procedure, Excluding Salmonids)
Mississagi River 1983 - 1987

Night Catch

Variable Log Total Catch By Substrate Type (cobble/sand/treated)

		Grp 2	Grp 1	Grp 3
Mean	Group	2	1	3
1.1922	Grp 2			
1.2143	Grp 1			
1.4654	Grp 3	*	*	

Variable Log Adult Catch By Year

		Grp 1	Grp 3	Grp 2
Mean	Group	1	3	2
0.8563	Grp 1			
1.1101	Grp 3	*		
1.2918	Grp 2	*		

Variable Log Adult Catch By Substrate Type (cobble/sand/treated)

		Grp 2	Grp 1	Grp 3
Mean	Group	2	1	3
1.0097	Grp 2			
1.0285	Grp 1			
1.3178	Grp 3	*	*	

Appendix D (cont'd)

Fish Catch Multiple Range Test (Duncan Procedure, Excluding Salmonids)
Mississagi River, 1983 - 1987

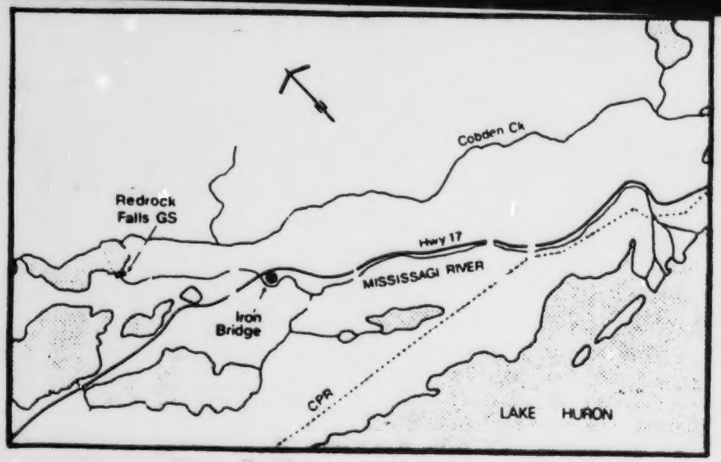
Variable Log Juvenile/Young of Year Catch By Year

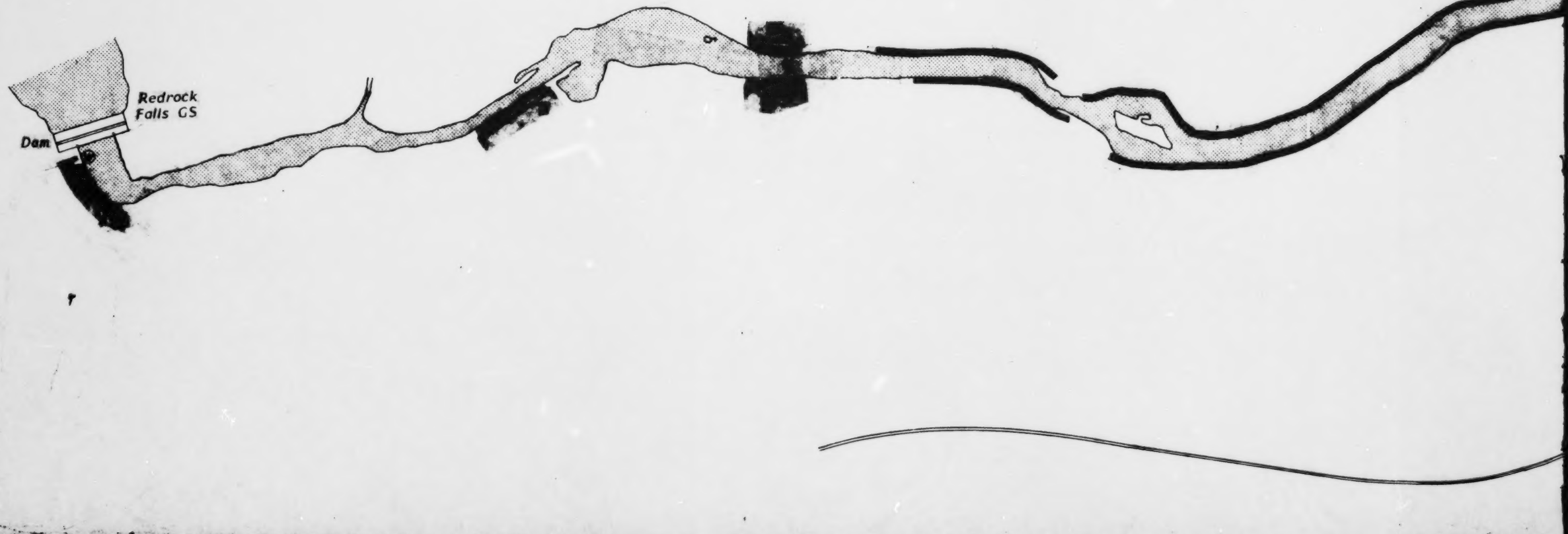
		Grp 2	Grp 3	Grp 1
Mean	Group	2	3	1
0.0540	Grp 2			
0.6855	Grp 3	*		
0.9586	Grp 1	*		

Variable Log Juvenile/Young of Year Catch By Substrate Type (Cobble/Sand/Treated)

		Grp 3	Grp 2	Grp 1
Mean	Group	3	2	1
0.2685	Grp 3			
0.5496	Grp 2			
0.7476	Grp 1	*		

* - denotes pairs of groups significantly different at the .050 level


Cobden Ck
Redrock
Falls GS
Hwy 17
MISSISSAGI RIVER
Iron
Bridge
CPR
LAKE HURON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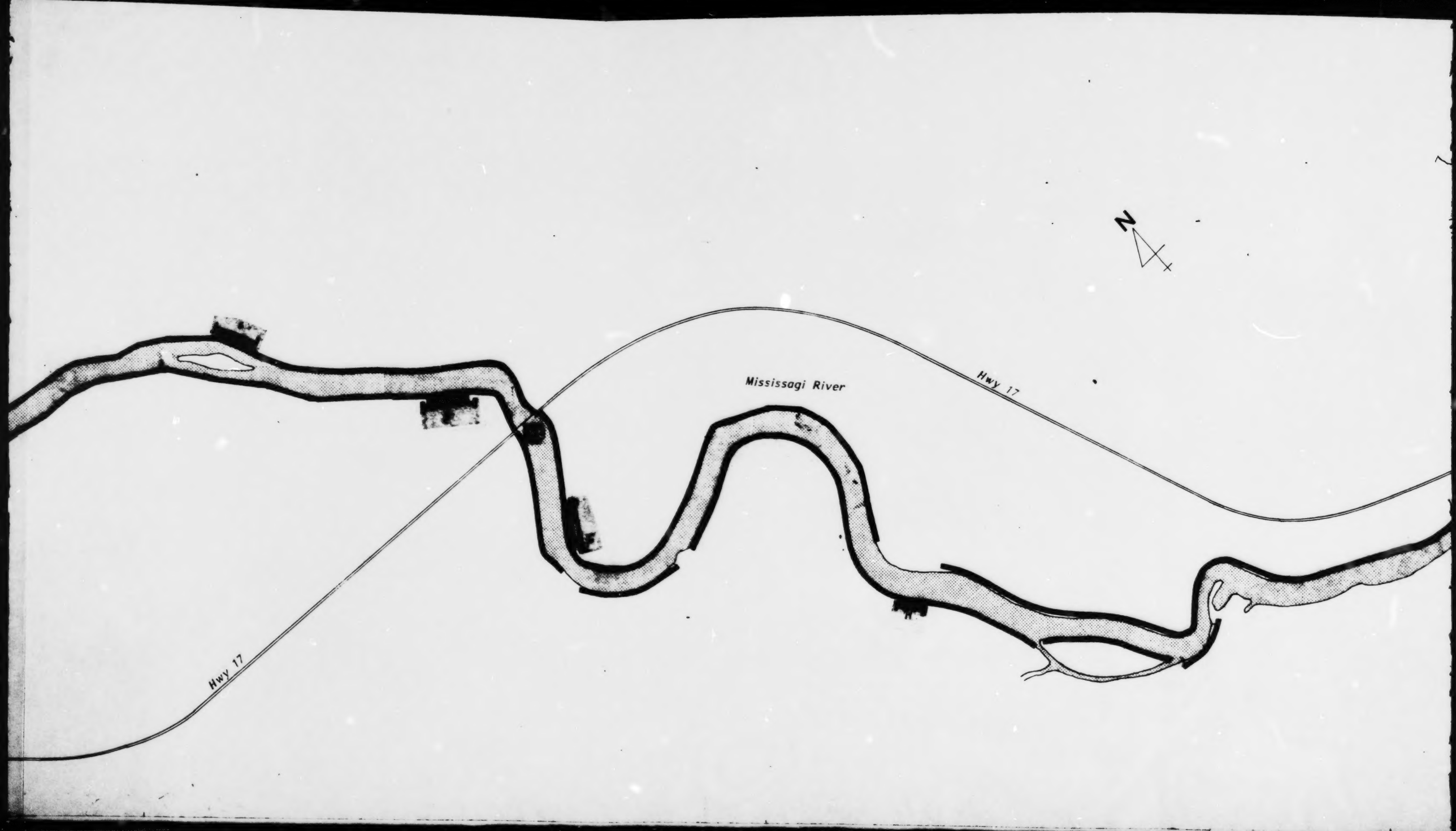
Falls GS
Dam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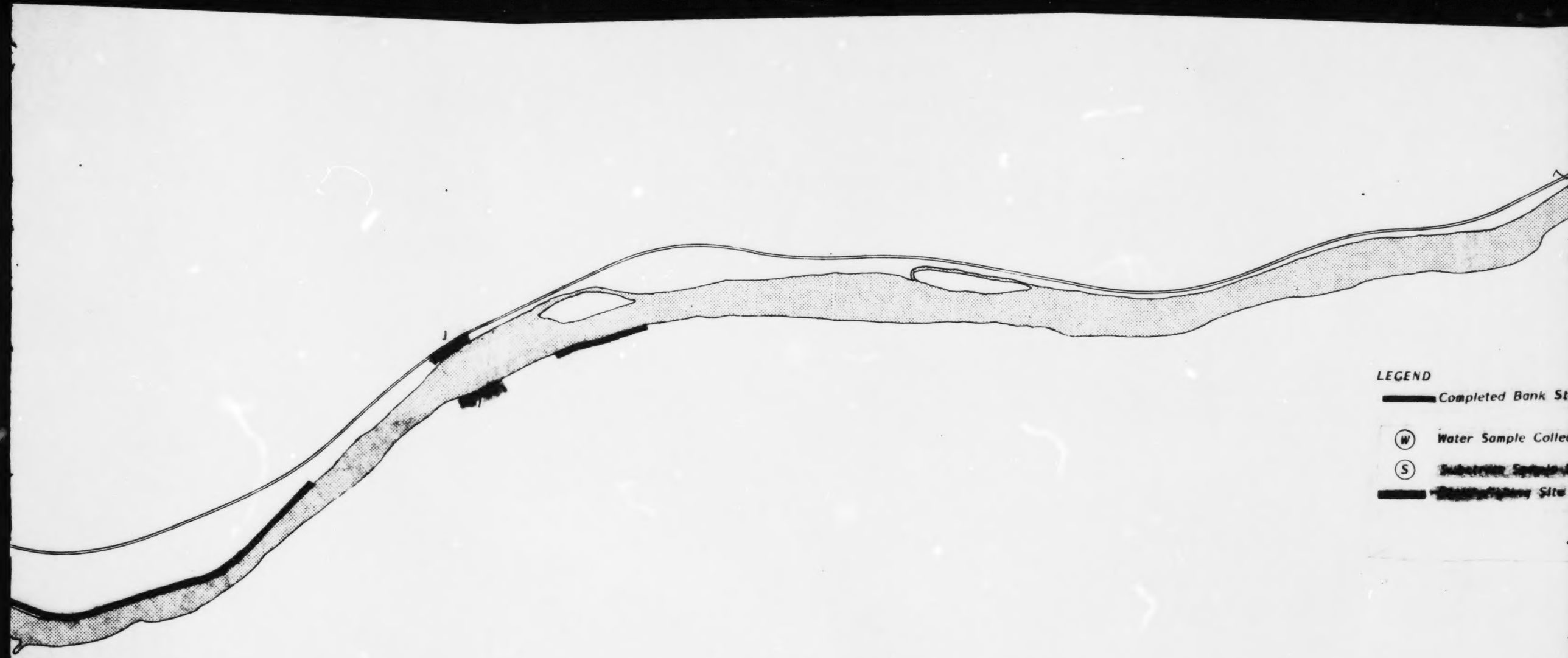
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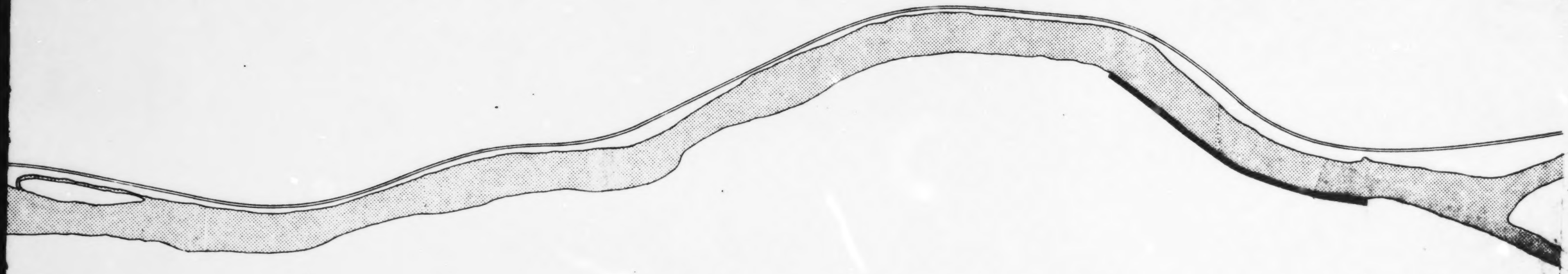
Completed Bank St
W Water Sample Colle
S



LEGEND

Completed Bank Stabilization

(W) Water Sample Collection Location

(S) Substrate Sample Location

Shoreline Site

SCALE

0 200 400 600 m

FIGURE 2.0-1
SAMPLING LOCATIONS AND
SHORELINE AREAS AFFECTED BY THE
EROSION CONTROL PROGRAM
MISSISSAGI RIVER, 1987

6751 RD